

## CLAIMS

That which is claimed is:

1. A recovery and purification system for a liquid medium from a slurry polymerization, the system comprising:
  - a first fluid passage connected at one end to a slurry polymerization reactor;
  - a flash gas separator connected to an opposite end of the first fluid passage, for separating a vapor stream comprising solid polymer particles in a liquid medium;
  - a vapor removal line connected at a top portion of the flash gas separator, for transporting the vapor stream from the flash gas separator;
  - a first condenser downstream of the vapor removal line;
  - a collection tank downstream of the first condenser;
  - a vapor bypass line providing a bypass for a portion of the vapor stream around the condenser to the collection tank;
  - a bypass valve for controlling the flow of vapor through the vapor bypass line;
  - a liquid delivery line at a bottom portion of the collection tank;
  - a vapor recycle line at a top portion of the collection tank;
  - a second condenser fluidly connected to the vapor recycle line; and
  - a second fluid passage connecting the output of the second condenser to the slurry polymerization reactor.
2. The recovery and purification system of claim 1, wherein the bypass valve is in informational communication with at least one of a temperature controller downstream of the collection tank and a level controller positioned within the collection tank.

3. The recovery and purification system of claim 2, wherein the level controller is in informational communication with the temperature controller, and the temperature controller is in informational communication with the bypass valve.
4. The recovery and purification system of claim 1 further comprising a heavies column connected at an opposite end of the liquid delivery line.
5. The recovery and purification system of claim 4 further comprising a flow controller disposed along the liquid delivery line.
6. The recovery and purification system of claim 4 further comprising a pump disposed along the liquid delivery line for propelling the liquid into the heavies column.
7. The recovery and purification system of claim 1 further comprising a static mixer fluidly connected to and downstream from the first condenser, and the static mixer is upstream from and fluidly connected to the collection tank.
8. The recovery and purification system of claim 1, further comprising a recycle tank disposed along the diluent recycle line downstream of the second condenser.
9. The recovery and purification system of claim 1 further comprising a purge column fluidly connected to receive solid polymer particles from the flash gas separator.
10. A process for recycling a liquid medium withdrawn from a slurry polymerization reactor, the method comprising:

separating a first vapor stream from a slurry comprising a liquid medium and solid polymer particles, wherein the vapor stream comprises at least the medium and heavies;

condensing a first portion of the first vapor stream in a first condensing zone to form a first liquid;

passing a second portion of the first vapor stream to a collection zone without passing through the first condensing zone;

separating a second liquid and a second vapor stream in the liquid collection zone;

passing the second liquid to a heavies purification zone; and

recycling the condensed medium to the slurry polymerization reactor without fractionating to remove heavies.

11. The recycling process of claim 10 further comprising the step of mixing together the first liquid and the second portion of the first vapor stream before passing to the collection zone.

12. The recycling process of claim 10 wherein the separating step yields solid polymer fluff having entrained diluent in addition to the vapor stream, and the method further comprises:

passing the solid polymer fluff from the flashing step to a purge zone wherein the purge zone extracts entrained diluent from the solid polymer fluff.

13. The recycling process of claim 10 wherein at least about 1% of the heavies in the first vapor stream are condensed into the second liquid.

14. The recycling process of claim 10 wherein at least about 5% of the heavies in the first vapor stream are condensed into the second liquid.

15. The recycling process of claim 10 wherein at least about 10% of the heavies in the first vapor stream are condensed into the second liquid.

16. The recycling process of claim 10 wherein at least about 2% of the oligomers in the first vapor stream are condensed into the second liquid.

17. The recycling process of claim 10 wherein at least about 10% of the oligomers in the first vapor stream are condensed into the second liquid.

18. The recycling process of claim 10 wherein at least about 20% of the oligomers in the first vapor stream are condensed into the second liquid.

19. The recycling process of claim 10 further comprising  
measuring the level of liquid in the liquid collection zone; and  
controlling the condensing of the vapor stream based on the measured liquid  
level.

20. A process for operating a slurry polymerization system, the process comprising the steps of:

forming a slurry comprising solid polyolefin particles in a liquid medium in a polymerization reaction zone;

withdrawing a portion of the slurry from the polymerization reaction zone;  
vaporizing the liquid medium to form a first vapor stream comprising at least the medium and heavies;

separating the first vapor stream from the solid polyolefin particles;  
passing a first portion of the first vapor stream to a condensation zone whereby a first liquid stream is formed;

passing a second portion of the vapor stream to a collection zone without passing through the condensation zone;

collecting the liquid stream and the second portion in the liquid collection zone;

separating a second vapor stream from a second liquid stream in the liquid collection zone;

condensing and recycling the second vapor stream back into the polymerization reaction zone without further heavies removal treatment; and

passing a second liquid stream to heavies removal treatment.

21. The operating process of claim 20 wherein the liquid medium is an inert diluent, and the solid polyolefin particles are polyethylene.

22. The operating process of claim 20 wherein the liquid medium is propylene, and the solid polyolefin particles are polypropylene.

23. The operating process of claim 20 further comprising passing the solid polyolefin particles to a purging step, where entrained diluent is extracted from the solid polyolefin particles.

24. The operating process of claim 20 further comprising measuring the level of liquid in the liquid collection zone and controlling the condensing of the first vapor stream based on the measured liquid level.

25. The operating process of claim 20 further comprising passing the second liquid stream from the collection zone to a heavies fractionation column.

26. The operating process of claim 20 further comprising the steps of:  
measuring the temperature of the vapor in the liquid collection zone; and

adjusting the amount of the first vapor stream being passed to the condensation zone in response to the measured temperature.

27. The operating process of claim 20 wherein the liquid removed from the collection zone contains at least about 1% of the heavies in the first vapor stream.

28. The operating process of claim 20 wherein the liquid removed from the collection zone contains at least about 5% of the heavies in the first vapor stream.

29. The operating process of claim 20 wherein the liquid removed from the collection zone contains at least about 10% of the heavies in the first vapor stream.

30. The operating process of claim 20 wherein the liquid removed from the collection zone contains at least about 2% of the oligomers in the first vapor stream.

31. The operating process of claim 20 wherein the liquid removed from the collection zone contains at least about 10% of the heavies in the first vapor stream.

32. The operating process of claim 20 wherein the liquid removed from the collection zone contains at least about 20% of the heavies in the first vapor stream.

33. The operating process of claim 20 wherein essentially all the heavies removed from the liquid collection zone are removed in liquid form.

34. The operating process of claim 20 wherein the second liquid stream is held in the liquid collection zone for a time sufficient to allow heavies from the vapor to transfer to the liquid.